

Rec'd PCT/PTO 19 JUL 2004

REPLACED BY
ART 34 AMDT

THE FOLLOWING IS THE ENGLISH TRANSLATION OF THE
AMENDMENTS TO THE INTERNATIONAL PRELIMINARY
EXAMINATION UNDER ARTICLE 34: Amended Sheets (pages 4,
5, 6, 7, 8, 9, 10, 40, 41, 42, 43, 44, 45, 46 and 46a)

current characteristics.

(2) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (1), the N-shaped voltage-current characteristic is continuously changed.

(3) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (2), the voltage-current characteristics approximate to the piecewise linear characteristics of third to seventh orders are realized.

(4) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (3), negative resistor portions in the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and in the voltage-current characteristic of the V-shaped nonlinear resistor circuit are linear as much as possible, and both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are moved in parallel in the left and right directions by a voltage between an input terminal of the Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of the V-shaped nonlinear resistor circuit and a drain terminal of a P-channel MOSFET, thus to combine the characteristic of the

third order.

(5) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (3), negative resistor portions in the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and in the voltage-current characteristic of the V-shaped nonlinear resistor circuit are linear as much as possible, and both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are moved in parallel in the left and right directions by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of the Λ -shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of the V-shaped nonlinear resistor circuit, thus to combine the characteristic of the third order.

(6) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (3), an inclination of a negative portion of the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of the V-shaped nonlinear resistor circuit is adjusted to change the inclination of the characteristic, and the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit or the voltage-

current characteristic of the V-shaped nonlinear resistor circuit is moved in parallel in the left and right directions by a voltage between an input terminal of the Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of the V-shaped nonlinear resistor circuit and a drain terminal of a P-channel MOSFET, thus to combine the fourth order characteristic.

(7) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (3), an inclination of a negative portion of the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of the V-shaped nonlinear resistor circuit is adjusted to change the inclination of the characteristic, and the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of the V-shaped nonlinear resistor circuit is moved in parallel in the left and right directions by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of the Λ -shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of the V-shaped nonlinear resistor circuit, thus to combine the fourth order characteristic.

(8) In the nonlinear resistor circuit using the

floating gate MOSFETs according to the description (3), inclinations of negative portions of both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are adjusted to change the inclinations of the characteristics, and both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are moved in parallel in the left and right directions by a voltage between an input terminal of the Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of the V-shaped nonlinear resistor circuit and a drain terminal of a P-channel MOSFET, thus to combine the fifth order characteristic.

(9) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (3), inclinations of negative portions of both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are adjusted to change the inclinations of the characteristics, and both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are moved in parallel in

the left and right directions by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of the Λ -shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of the V-shaped nonlinear resistor circuit, thus to combine the fifth order characteristic.

(10) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (3), an inclination of a negative portion of the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of the V-shaped nonlinear resistor circuit is adjusted to change the inclination of the characteristic, and both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are moved in parallel in the lateral axis direction by a voltage between an input terminal of the Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of the V-shaped nonlinear resistor circuit and a drain terminal of a P-channel MOSFET, thus to combine the sixth order characteristic.

(11) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (3), an

inclination of a negative portion of the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of the V-shaped nonlinear resistor circuit is adjusted to change the inclination of the characteristic, and both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are moved in parallel in the lateral axis direction by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of the Λ -shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of the V-shaped nonlinear resistor circuit, thus to combine the sixth order characteristic.

(12) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (3), inclinations of negative portions of both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are adjusted to change the inclinations of the characteristics, and both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are moved in parallel in the lateral axis direction by a voltage between an input

terminal of the Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of the V-shaped nonlinear resistor circuit and a drain terminal of a P-channel MOSFET, thus to combine the seventh order characteristic.

(13) In the nonlinear resistor circuit using the floating gate MOSFETs according to the description (3), inclinations of negative portions of both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are adjusted to change the inclinations of the characteristics, and both the voltage-current characteristic of the Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of the V-shaped nonlinear resistor circuit are moved in parallel in the lateral axis direction by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of the Λ -shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of the V-shaped nonlinear resistor circuit, thus to combine the seventh order characteristic.

Brief Description of the Drawings

Fig. 1 is a diagram showing an N-shaped nonlinear resistor circuit using floating gate MOSFETs according to

CLAIMS

1. A nonlinear resistor circuit using a floating gate MOSFETs, wherein a Λ -shaped nonlinear resistor circuit using a multi-input floating gate MOSFET and a V-shaped nonlinear resistor circuit using a multi-input floating gate MOSFET are connected in parallel therewith and current of said Λ -shaped nonlinear resistor circuit and current of said V-shaped nonlinear resistor circuit are added, thus to combine various N-shaped voltage-current characteristics.

2. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 1, wherein said N-shaped voltage-current characteristic is continuously changed.

3. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 2, wherein the voltage-current characteristics approximate to piecewise linear characteristics of third to seventh orders are realized.

4. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein negative resistor portions in the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and in the voltage-current characteristic of said V-shaped nonlinear resistor circuit are linear as much as possible, and both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped

nonlinear resistor circuit are moved in parallel in the left and right directions by a voltage between an input terminal of said Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of said V-shaped nonlinear resistor circuit and a drain terminal of a P-channel MOSFET, thus to combine the characteristic of the third order.

5. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein negative resistor portions in the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are linear as much as possible, and both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are moved in parallel in the left and right directions by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of said Λ -shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of said V-shaped nonlinear resistor circuit, thus to combine the characteristic of the third order.

6. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein an inclination of a negative portion of the voltage-current characteristic of

said Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of said V-shaped nonlinear resistor circuit is adjusted to change the inclination of the characteristic, and the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of said V-shaped nonlinear resistor circuit is moved in parallel in the left and right directions by a voltage between an input terminal of said Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of said V-shaped nonlinear resistor circuit and a drain terminal of a P-channel MOSFET, thus to combine the fourth order characteristic.

7. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein an inclination of a negative portion of the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of said V-shaped nonlinear resistor circuit is adjusted to change the inclination of the characteristic, and the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of said V-shaped nonlinear resistor circuit is moved in parallel in the left and right directions by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of said Λ -

shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of said V-shaped nonlinear resistor circuit, thus to combine the fourth order characteristic.

8. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein inclinations of negative portions of both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are adjusted to change the inclinations of the characteristics, and both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are moved in parallel in the left and right directions by a voltage between an input terminal of said Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of said V-shaped nonlinear resistor circuit and a drain terminal of a P-channel MOSFET, thus to combine the fifth order characteristic.

9. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein inclinations of negative portions of both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor

circuit are adjusted to change the inclinations of the characteristics, and both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are moved in parallel in the left and right directions by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of said Λ -shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of said V-shaped nonlinear resistor circuit, thus to combine the fifth order characteristic.

10. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein an inclination of a negative portion of the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of said V-shaped nonlinear resistor circuit is adjusted to change the inclination of the characteristic, and both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are moved in parallel in the lateral axis direction by a voltage between an input terminal of said Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of said V-shaped nonlinear resistor circuit and a drain

terminal of a P-channel MOSFET, thus to combine the sixth order characteristic.

11. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein an inclination of a negative portion of the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit or the voltage-current characteristic of said V-shaped nonlinear resistor circuit is adjusted to change the inclination of the characteristic, and both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are moved in parallel in the lateral axis direction by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of said Λ -shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of said V-shaped nonlinear resistor circuit, thus to combine the sixth order characteristic.

12. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein inclinations of negative portions of both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are adjusted to change the inclinations of the characteristics, and both the voltage-current characteristic

of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are moved in parallel in the lateral axis direction by a voltage between an input terminal of said Λ -shaped nonlinear resistor circuit and a drain terminal of an N-channel MOSFET and a voltage between an input terminal of said V-shaped nonlinear resistor circuit and a drain terminal of a P-channel MOSFET, thus to combine the seventh order characteristic.

13. The nonlinear resistor circuit using the floating gate MOSFETs according to Claim 3, wherein inclinations of negative portions of both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are adjusted to change the inclinations of the characteristics, and both the voltage-current characteristic of said Λ -shaped nonlinear resistor circuit and the voltage-current characteristic of said V-shaped nonlinear resistor circuit are moved in parallel in the lateral axis direction by a voltage between the ground and a drain terminal of a floating gate P-channel MOSFET of said Λ -shaped nonlinear resistor circuit and a voltage between the ground and a drain terminal of a floating gate N-channel MOSFET of said V-shaped nonlinear resistor circuit, thus to combine the seventh order characteristic.